8. A HISTORY OF FLOODING IN SOUTHERN QUEBEC, CANADA

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18. A HISTORY OF FLOODING IN SOUTHERN QUEBEC, CANADA

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ABSTRACT

The flood hazard in southern Quebec is a well-known phenomenon in an anecdotal sense, but it has never been studied in detail. This project examines the nature and history of flooding in the Massawippi River drainage basin during the 20th Century. Field surveys, map analyses, and historical data from local print media and archives were used as information sources. Over the 100-year study period, 1900 to 1999, 65 years experienced flood events, 95 total events took place. The majority, and the largest events, occurred during the months of March and April, with less frequent events during brief periods of winter thaw and during intense summer thunderstorms. The area immediately south of the town of Lennoxville, at the drainage basin outlet, was the location for most flood events, with the largest flood of the study period occurring there in April 1994. Flood costs include infrastructure damage to communication and transportation corridors, and commercial and personal losses related to water and sediment inundations. Events were initiated by a combination of extensive, rapid snowpack melt and sudden, intense rainstorms. The geomorphology of the drainage basin, especially its relatively large size and near-circular shape, contributed to the periodicity and intensity of the floods. There is historical evidence to suggest flood events have increased in frequency during the last three decades of the century.

1 INTRODUCTION

People living in the towns and rural areas of the Massawippi Basin, including Lennoxville, Coaticook, North Hatley, Stanstead, Ayer's Cliff and points in between, have become used to the arrival of the spring flood event. A Thursday, April 19, 1900 account taken from *The Sherbrooke Daily Record* accurately portrays the familiarity with this frequent event:

"FLOOD IS HERE

The spring freshet is now on in earnest. The rain of Monday was the beginning. Since then the water has been steadily rising and yesterday afternoon passed the capacity of the river channel and overflowed the banks…Below the city on both sides of the river, the highways are flooded and teams can only pass by fording…The road between Lennoxville and Huntingville is submerged…Those who have watched the progress of the spring floods for many years past predict a record breaker this year." (p. 1)

V.R.Thorndycraft, G. Benito, M. Barriendos and M.C. Llasat (2003). Palaeofloods, Historical Floods and Climatic Variability: Applications in Flood Risk Assessment (Proceedings of the PHEFRA Workshop, Barcelona, 16-19th October, 2002).

During the 20th century (defined here as the ten-decade period 1900 – 1999), rivers in this basin went on to overflow their banks in 65 out of the 100 years, during 95 separate events. Unfortunately, the history of flooding in this region of southern Quebec is not well documented. The purpose of this paper is to provide a descriptive account of flood events that occurred in the Massawippi Basin during the 20th century. Based on newspaper reports from *The Sherbrooke Record, The Townships Sun, La Tribune* and *The Montreal Gazette*, and information provided by Environment Canada, the Lennoxville-Ascot Historical and Museum Society, Musée du Seminaire de Sherbrooke and the Eastern Townships Research Centre, a geographical history of these events will be provided. The timing and location of the flooding, causes of floods, and reactions of the media will be presented. Using climate data provided by Environment Canada, comparisons between the timing of historical floods and climate Normals for the period 1888-1990 will be made. This study is a detailed historical analysis building on, and expanding, the short history of flooding in the Massawippi Basin presented by Jones (1999), the only recent publication available on this subject for the study area.

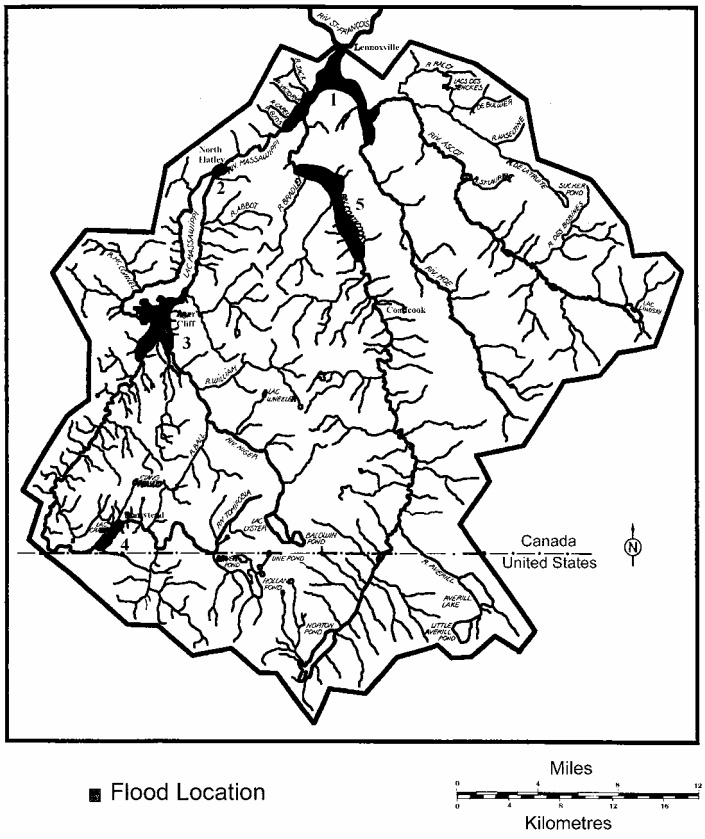

Figure 1. Study Area Map with Flood Locations.

The study area includes all terrain drained by the Massawippi River and its tributaries (Figure 1). The basin has a total area of 1670 km^2, a quasi-circular shape and the terrain is one of rolling hills with an overall slope to the north. Principal tributaries include the Coaticook, Moes, Ascot (Salmon), Tomifobia and Niger Rivers. A total of over 2000 km of stream channels exist within the Massawippi Basin, however most of these channels are relatively short, less than 4 km in length. The only extensive water body that interrupts stream channel flow in the basin is Lake Massawippi. Smaller water bodies, including Lakes Lyster and Averill, and Norton and Little Averill Ponds are located at the periphery of the basin, acting as water collection points for streams. All streams follow the regional

slope running in a generally north-south direction, eventually coming together as the Massawippi River, which discharges its volume into the St. Francis River at Lennoxville.

2 FLOOD CHARACTERISTICS

The spring thaw or freshet, as it was termed at the beginning of the century, is usually accompanied by heavy rains, increases in temperature leading to quickly melting deep snowpacks and/or river ice jams. Any of these factors may produce a flood event, however when these conditions act in concert they produce enough water to deliver an event with disastrous consequences. Environment Canada provides the average annual precipitation for Lennoxville, for the years 1888 to 1990, as 104 cm; 80 cm of it is rain and 24 cm (water equivalent) of snow. July and August are the wettest months with 108 cm and 119 cm of precipitation; January and February are the driest months with 67 cm and 59 cm of precipitation. Total snow cover normally peaks at the end of February, at 33 cm; March is the month with greatest snow melt, normally leaving only 8 cm on the ground at the end of the month.

The normal average temperature provided by Environment Canada for the 1888 to 1990 period for Lennoxville is 5.3 ^{0}C . The greatest average temperature drop occurs between November and December: 1.0 to –7.1 ^{0}C; the greatest rise is between March and April: -2.9 to 4.8 ^{0}C. In both cases the threshold freezing point of 0 ^{0}C is crossed. In the latter case this produces important water, in terms of flood potential, to stream channels through the melt of most of the snowpack. In addition, the late March/early April period is when any existing river and/or lake ice breaks up and begins to float downstream, producing the potential for ice jams. At this time of year the ground remains partially frozen and/or water-saturated, reducing meltwater infiltration into the soil and increasing runoff to the nearby streams.

3 FLOOD LOCATIONS

The principal locations of floods in the Massawippi basin are shown on Figure 1 (cf, Jones 1999). All of these locations are susceptible to flooding primarily because of their low elevations, less than 150 metres above sea level. Secondarily, Locations 1 and 3 are areas of major river confluence; ice jams are influential at Locations 1, 2 and 3. At Location 1 bridges over the Massawippi River and the confluences of the Massawippi with the Moes and Coaticook Rivers are key points of channel constriction, and water and ice build-up. At Location 2 a dam present immediately downstream of Lake Massawippi provides a constriction point. The confluence of the Moes and Ascot Rivers is a location of water build-up and flood potential, as is the confluence of the Massawippi and Niger Rivers at Ayer's Cliff, Location 3. Location 4 at Stanstead is the least flooded one, simply being an area of low elevation. Location 5 represents a highly meandering reach of the Coaticook River. Each meander bend provides a possible point of water build-up and overflow. Between each bend are riffles, stretches of the river with bottom sediment accumulation causing shallows, and thus areas where the potential for ice jamming and channel overflows is increased.

4 FLOOD HISTORY

Other than Jones (1999) there are no studies or records kept of flood events in the Massawippi drainage basin. Therefore, it is necessary to compile a history of flooding from

an analysis of local print media. Newspaper accounts have the advantage of easy accessibility and using several sources increases the chance of a flood event being recorded for inclusion. One major disadvantage of this research method is the propensity for newspapers to cover only major events, overestimate damages and, occasionally, confuse flood damage with erosion damage (Kreutzwiser and Gabriel, 1992). The possibility of the newspapers utilized in this study covering only major events is low; the ones used are local newspapers that attempt to report all local events, large or small. Additional, general information on the flood history of southern Quebec came from government publications and web sites (e.g.: Andrews, 1993; Environment Canada: http://www.cmc.ec.gc.ca/climate/normals), the Lennoxville-Ascot Historical and Museum Society, the Musée du Seminaire de Sherbrooke and the Eastern Townships Research Centre.

Spring floods (March to May), caused by a combination of snowmelt, rain and ice jams, are by far the most common type occurring in this part of the Eastern Townships. March and April are the two most common months for flooding, with 63 of the 95 separate flood events that have occurred in the 20th century in the Massawippi Basin occurring during these two spring months, 42 of them in April (Fig. 2). (Note: In this study individual events are defined as those occurring at least three days apart.) These floods also, as a rule, tend to be the most destructive floods on record.

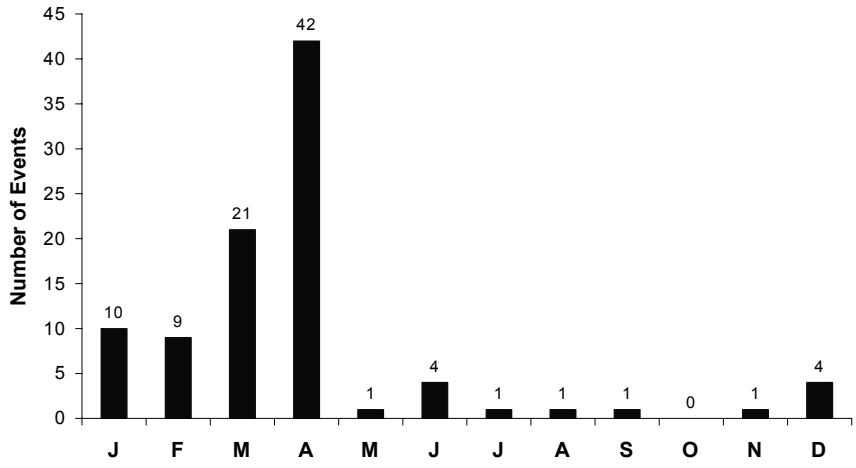

Figure 2. Flood Events Per Month 1900 to 1999.

Of the fifteen most significant flood events in the basin during the 20th century, twelve occurred during March and April. The fifteen significant flood events are those which, based on archival information, caused the highest amounts of damage to infrastructures and larger disruptions to transportation and communication. Three of the most destructive were the events of March 6-8, 1979, April 17-19, 1982 and April 16, 1994. In each case flooding occurred due to a combination of heavy rain, massive snowmelt and ice jams (ie, Composite events). Bridges were damaged, farms flooded and livestock lost, people evacuated from their homes, roads closed. Location 1 (Fig. 1), at and upstream of Lennoxville was usually hit hardest: Bishop's University, built on the floodplains of both the St. Francis and Massawippi Rivers, suffered extensive flood damage, as did the Beaulieu and Wera farms located on the floodplain, or 'flats', south of town.

Floods are not restricted to the spring season; winter thaws and summer thunderstorms add to the flood hazard. December, January and February have seen a total of 23 flood events over this 100-year period. Unseasonally warm temperatures causing snowmelt and heavy rains usually produce these floods. Ice jams often exacerbate the flood hazard during these months. One significant event occurred on January 10, 1935 when a composite flood caused heavy damage in the Coaticook area (Location 5, Fig. 1). Roads were closed, a bridge destroyed and farms inundated with flood waters.

The summer months of June to August have experienced a total of 6 events occurring during the century. These are what are termed flash floods, initiated by intense summer thunderstorms, and usually taking place on steep slopes. Where the ground is unstable and/or barren of vegetation, severe erosion and debris flows have occurred during these events. June has seen two of the most destructive events of the century. During two consecutive years, 1942 and 1943, heavy rains produced flash floods. These two days saw some of the heaviest rain recorded for the Massawippi Basin in history; property damages were high, transportation corridors were disrupted and low-lying farms inundated. In addition, steep slopes on Montjoie were heavily eroded causing small debris flows that added to the disruption of local roads. Autumn is seldom a season for flooding. Only two 20th Century events are documented for the months of September, October and November. These occurred after unusually intense rainstorms caused flash floods.

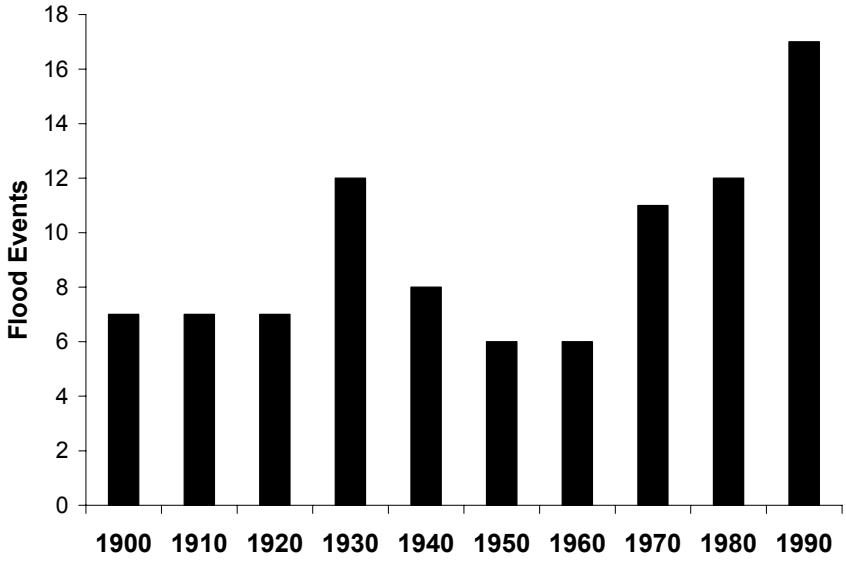

Figure 3. Flood Events Per Decade 1900 to 1999.

Autumn is seldom a season for flooding. Only two 20th Century events are documented for the months of September, October and November. These occurred after unusually intense rainstorms caused flash floods. Occasionally, like the September 20, 1999 event, the nearby passing of a hurricane, in this case Hurricane Floyd, was blamed for the heavy rain.

As mentioned above, there has been a total of 95 flood events documented in 65 of the years of the 20th century. There has been no decade free of floods. There has been a slight increase in the reporting of these events in the latest part of the century (Fig. 3). The early decades, with the exception of the 1930s when there were 12 events, normally experienced 6 to 8 events per decade. The decades with the fewest flood events were the 1950's and 1960's when only 6 events occurred in each decade. The 1970s saw this number rise to 11,

followed by 12 in the 1980s and the highest number of events (17) in the last decade, the 1990's, partly because of one unusually hazardous year, 1996; in that year 7 different events were reported. These data and the trend they seem to show are, without question, preliminary and require more detailed study in order to prove that a definite trend to an increase in flood events over time is occurring.

5 CONCLUSION

An analysis of the history of flooding in the Massawippi Drainage Basin during the 20th Century has revealed a number of interesting facts. It has been shown that flood events were, as expected from anecdotal evidence, frequent and occasionally destructive. Flood costs included infrastructure damages to communication and transportation corridors, economic disruption and losses on agricultural lands, personal inconvenience related to evacuations and personal losses related to floodwater and stream sediment inundations of homes, and business losses due to service disruptions and direct floodwater damages. Also, there is some evidence that flood events have increased in number toward the last part of the century, however the information supporting this contention is not detailed. This apparent increase may be simply related to improved reporting techniques by the local newspapers. It may be related to an increase in winter snowfall accumulations and large spring rainstorm events; further investigation of climate data is necessary in order to verify this statement. It has also been shown that, although flooding occurs throughout the Massawippi Basin, the area near and immediately south of Lennoxville is the site of most flooding. Here the floodwaters from the entire basin accumulate, the topography is flat with an extensive floodplain, and bridges occur which can create ice jams. Much of the damage associated with the flooding of the Lennoxville area is economic damage of local farms located on the floodplain south of town.

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